From the Individual to the Group: Integrating Asynchronous Collaboration with Co-located Work

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ABSTRACT

A large amount of data analysis work is conducted by individuals interspersed with formally arranged or spontaneous face-to-face meetings. Visual analytics tools provide no easy solution to bridge the gap between such individual and face-to-face work situations. They are typically either designed to work well for individuals or for teams but do not support to be used interchangeably in both synchronous and asynchronous work settings. In order to make collaboration effortless and worth undertaking, however, individuals have to be able to fluidly switch in and out of synchronous collaboration with others, to bring their own data, its visual representations, as well as all data modifications and annotations to a shared meeting where both data and representations can not only be presented but also interacted with, modified, and further analyzed together with others.

1. INTRODUCTION

Social exchanges around data are fairly common, people gather information together, discuss it, share it, form joint decisions based on it, or present it to others. Ultimately, supporting this collaborative nature of data analysis in new technology contexts can empower humans to more effectively and intuitively make use of information whenever and wherever it is needed the most. Yet, while the first tools to support both synchronous face-to-face (e. g., [1, 5]) and asynchronous distributed collaboration [4] are emerging, very little has been done to build bridges between the different types of collaboration.

In this position statement we argue that—to truly support asynchronous and synchronous collaborative work phases—it is essential to support a tighter integration of asynchronous single-user and synchronous multi-user analytics tools and techniques. We have to tackle fundamental problems of technological infrastructure and the design of data representation and interaction to build a bridge between individual (asynchronous) and team work for visual data analysis. The main challenge of this research is that hardly any design considerations exists on how data analysis phases of individual (asynchronous) and synchronous collaborative work relate to each other, when people switch between both types of analysis, for which types of questions and tasks, and what types of data analysis collaborations they want to engage in.

We are currently working on a research project that involves a stream of research modules, starting from fundamentally extending visualization toolkits for collaborative work and researching the necessary interaction and visualization mechanisms that will allow for a seamless and effortless setup of face-to-face data analysis with visualizations from phases of individual, asynchronous work. This is challenging because existing tools, designed for a one-user setting, are notoriously difficult to adapt to a collaborative setting. The problems come from several levels: low-level access to multiple input devices, management of these devices in existing libraries and toolkits, the lack of support for higher-level mechanisms to support collaboration such as per-user undo/redo or interactive feedback of other users' activity to prevent conflicts, or the dedicated interfaces and visual design that are required for large interactive wall or tabletop displays. Fig. 1 gives an overview of our research focus.

2. RESEARCH GOALS

The goal of our research is to devise technologies which best enable face-to-face collaborative data analysis as an integral part of the continuum between single-user asynchronous and multi-user synchronous work. Our work is motivated by previous observational studies in a biological research lab where the need to bridge from individual to collaborative work on the analysis of experimental data was particularly evident. Biologists frequently engaged in paper-based discussions about printed data from their experiments with their colleagues, to ask their opinion and advice. Without proper collaborative technology, however, they could not compare to data from past experiments, modify the data they were examining, or easily share it. In business settings similar problems exist. Here decisions makers frequently come together in meeting rooms to analyze and discuss data and form decisions. This data is typically presented in forms of charts and graphs on digital slide shows which can no longer be modified, interacted with, or re-represented. The collaborative meetings we observed were entirely disconnected from the previous individual work which had been done on the data and could no longer take advantage of these past work processes. It is these and similar scenarios that have a clear need for tools that support an interplay of asynchronous and synchronous face-to-face collaboration. A few of the

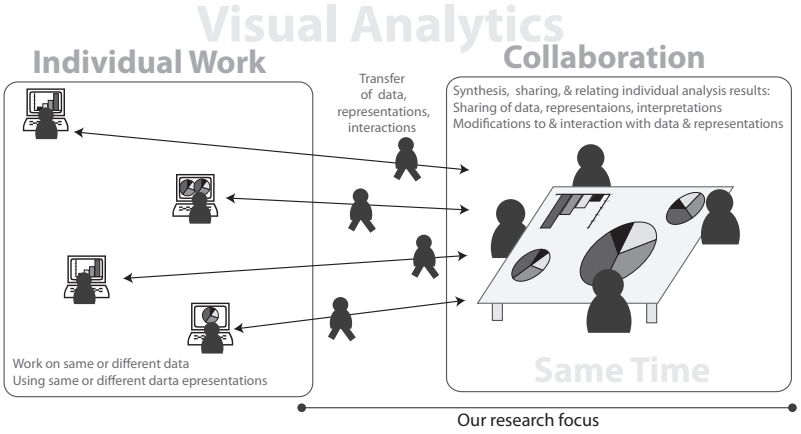

Figure 1: The research focus and challenges of our work on the interplay of asynchronous and synchronous collaborative visual analytics.

challenges we would like to address are:

2.1 Infrastructure Challenges

For building groupware, several toolkits and frameworks exist but none provide dedicated capabilities for building visualization applications. In order to make visualization toolkits groupware-ready, it is important to study the structure of both. Our goal is to review groupware toolkits for their features and software design with a focus on those that support synchronous, co-located work. This work will be important to derive basic software requirements for extending visualization toolkits. Ultimately, we want to deliver results on the underlying software and algorithms necessary to bridge between single-user to multi-user visualization tools and allow others to more easily build integrated single-user/collaborative visualization tools.

2.2 Interaction and Visualization Challenges

On the interaction design-side our goal is to develop mechanisms for shared workspaces to give each individual team member effective access to shared resources while dropping in- and out of a collaborative workspace. This will also include metaphors for adding and taking visualization to a collaborative workspace, for sharing data visualizations and their parameters, and for data modification in a shared setting. A first step towards this goal will be presented at the conference [2]. We further plan to research how asynchronously used single-user visualizations have to be modified for the collaborative workspace. We will specifically research modifications to provide support for awareness, common ground formation, and data synthesis [3]. We will begin to introduce these modifications in form of meta-visualizations. In order to build these meta-visualizations we will develop algorithms which aid in automatic synthesis and comparison of data and their visual representations that individuals bring to a joint analysis session. These algorithms will provide the data which the meta-visualizations represent and which in turn aid users of the collaborative workspace to see how their past work relates, can be synthesized, organized, and further analyzed.

2.3 Evaluation Challenges

We plan to evaluate our work and expect to encounter challenges in studying tools and applications situated at the intersection of asynchronous and synchronous work. In particular, it will be challenging to study multiple asynchronous work settings in depth so that the synchronous collaborative work phases can be readily understood and effectively evaluated.

3. CONCLUSION

In summary, we hope to provide researchers and practitioners with (1) clear design considerations for developing visualization systems which are useful and usable for both individual as well as collaborative work, (b) practical tools in the context of a toolkit on which to build for promoting collaborative visualization use in a variety of application domains, and (c) results from validation and iterative improvement of the techniques which are meant to bridge between individual and collaborative work.

4. ACKNOWLEDGMENTS

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